Report on a Braille Administration of the Stanford Achievement Test (Verbal Tests)

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SUMMARY

Forty-three visually impaired students with an average age of 11 years were given a braille version of three tests from the Stanford Achievement Test (SAT). The three tests were: Language, 53 items; Word Study, 60 items; and, Spelling, 40 items. Score distributions for the three tests were negative, indicating an excess of scores at the high end of the range. Also, difficulty levels for most items were .70 or more; on the Language test especially, several items were marked correctly by a high proportion of students. Internal consistency reliability coefficients (Cronbach's alpha) were .81, .90, and .87 for the Language, Word Study, and Spelling tests, respectively. Several relationships among test scores and demographic variables were explored and reported.

This report summarizes data analysis from a braille administration of the Stanford Achievement Test (SAT). A total of 43 visually impaired youngsters were tested. All subjects received the same materials: three verbal-domain tests from the SAT. Each test had a multiple-choice format and was indentified as follows: Language, 53 items; Word Study, 60 items; and Spelling, 40 items. Right and wrong responses were calculated for each item on the three tests, as well as the total score (i.e., number correct) for each test. In addition, several demographic variables were measured on subjects (e.g., age) and related to test performance.

Demographic variables

Table 1 shows a summary of three variables related to age and schooling. The age of students ranged from 171 to 109 months (14.1 years to 9.1 years). The average was about 134 months (11.2 years of age). The great majority of students (79%) were blind from birth. The average number of years of schooling was about 6 years.

Table 2 shows data on three variables related to instructional experiences of the students. The number of years of instruction in braille ranged from 8 to 2, with the average student having 5 years. For this sample of subjects, instruction in contracted braille started early: over 70% had started by grade 2 or earlier. Similarly, spelling instruction began for 80% of the students at grade 1 or kindergarten.

Table 3 gives data on the final three demographic variables.

About three-fourths of the sample came from public schools and one-fourth from residential schools. About 56% were placed at grade 5 for reading purposes and 44% at grade 4. Finally, the students were given a rating in intelligence by their teachers. Most students were rated average or high in IQ.

Table 1

Frequency Distributions and Descriptive Statistics on the Variables: Age in Months, Age at Onset of Blindness, and Number of Years in School

Age in Months

Number of months	f	%
143 - 171	9	20.9
134 - 142	10	23. 3
127 - 133	11	25.6
109 - 126	13	30.2
	43	100.0

Mean = 134.1 SD = 13.5
Median = 132.0 Range = 62.0
Skewness = 0.7

Age at Onset of Blindness

Years of age	f	%
7	1	2.3
6	2	4.7
5	1	2.3
4	1	2.3
3	1	2.3
2	3	7.0
Birth	34	79 .1
	43	100.0

Number of Years in School

Number of years	f	%
8	4	9.3
7	12	27.9
6	16	37.2
5	10	23.3
4	1	2.3
	43	100.0

Mean = 6.2 SD = 1.0
Median = 6.0 Range = 4.0
Skewness = 0.1

Table 2

Frequency Distributions and Descriptive Statistics on the Variables: Years of Braille Instruction, Grade Contracted Braille Was Required, and Grade Spelling Instruction Began

Years of Braille Instruction

Number of years	f	%
8	1	2.3
7	5	11.6
6	15	34.9
5	11	25.6
4	9	20.9
3	2	4.7
	43	100.0

Mean = 5.3 SD = 1.2
Median = 5.0 Range = 5.0
Skewness = - 0.1

Grade Contracted Braille Was Required

Grade	f	%
4	3	7.0
3	8	18.6
2	10	23.3
1	17	39.5
Kindergarten	5	11.6
	43	100.0

Grade Spelling Instruction Began

Grade	f	%
3	1	2.3
2	6	14.0
1	28	65.1
Kindergarten	8	18.6
	43	100.0

Table 3

Frequency Distributions on the Variables: School Setting, Reading Placement (Grade Level), and IQ Based on Teacher Judgement

Variable	Frequency distribution		
School Setting	Category	f	%
	Public	32	74.4
	Residential	11	25.6
		43	100.0
Reading Placement (Grade Level)	Grade	f	%
	5	24	55.8
	4	19	44.2
		43	100.0
IQ Based on Teacher Judgment	Category	f	%
	High IQ	17	39.5
	Average IQ	18	41.9
	Low IQ	4	9.3
	Missing	4	9.3
		43	100.0

Test Score Distributions and Psychometric Properties of the Tests

Score distibutions were constructed and descriptive statistics calculated for the three tests. These data are shown in Table 4. All three distributions were negatively skewed, indicating that a proportionally greater number of students got high scores than low scores.

Reliability coefficients and other results pertinent to the psychometic properties of the tests are shown in Table 5. Cronbach's alpha, probably the most popular type of internal consistency reliability coefficient, was about .90 for both the Word Study and Spelling tests and .81 for the Language test. The average item mean was .70 or greater for all the tests. Since the items were scored so that a one meant correct and a zero incorrect, .70 is the proportion of students that got a typical item correct. The average iter-item correlation was near .15 for the Word Study and Spelling tests, and was .07 for the Language test. These data are consistent with the the relationship among reliablity coefficients for the three tests. They indicate that the items in the Language test were not as strongly related to one another as were the items within the Word Study test and the items within the Spelling test. Regarding difficulty of items, almost 20% of the items in the Language test were answered correctly by .90 or more of the students. Thus, a fairly significant number of items were easy for students. Fewer items were as easy in the Language or Spelling tests. (Note. On the

Language test, three items were missed by only one student. These were item numbers 16, 17, and 41. On the Word Study test, items 25 and 43 were missed by only one student. All Spelling items were missed by more than one student.)

Table 4

Frequency Distributions and Descriptive Statistics on the Variables: Language Score, Word Study Score, and Spelling Score

Variable	Frequency distribution and statistics		
Language Test Score (53 items)	Language Score	f	%
	46 - 49	9	20.9
	42 - 45	10	23.3
	37 - 41	12	27.9
	22 - 36	12	27.9
		43	100.0
	Mean = 39.67	SD = 6.69	
	Median = 41.00	Range = 27.00	
	Skewness = - 0.74		
Word Study Test Score (60 items)	Word Study Score	f	%
	52 - 57	10	23.3
	47 - 51	10	23.3
	38 - 46	10	23.3
	19 - 37	13	30.2
		43	100.0
	Mean = 42.42	SD = 10.11	
	Median = 44.00	Range = 38.00	
	Skewness = - 0.49		
Spelling Test Score (40 items)	Spelling Score	f	%
	36 - 39	10	23.3
	31 - 35	10	23.3
	28 - 30	10	23.3
	12 - 27	13	30.2
		43	100.0
	Mean = 29.65	SD = 6.97	
	Median = 30.00	Range = 27.00	
	Skewness = - 0.74		

Table 5

Reliability Coefficients and Item Characteristics for Language, Word Study, and Spelling Tests

	Test		
	Language (53 items)	Word Study (60 items)	Spelling (40 items)
Internal consistency reliability coefficients			
Cronbach's alpha	.8136	.9046	.8752
Guttman's split-half	.7409	.8300	.8205
Spearman-Brown	.7490	.8306	.8277
Parallel model (unbiased estimate)	.8224	.9091	.8811
Average item mean	.7486	.7070	.7413
Average inter-item correlation	.0730	.1420	.1538
	n %	n %	n %
Number and percentage of items with a mean value $\geq$ .90	8 19	6 10	3 8

Relationships Among Demographic Variables and Test Scores

Since demographic variables were available on subjects, it was decided to explore how these might be related to test scores. First, comparisons were made on mean test scores compared on levels of the demographic variables. In order to carry out these analyses, the demographic variables were recoded so that roughly equal numbers of subjects were in levels of a given variable. Then, a one-way analyis of variance or independent *t* test was performed with the demographic variable as the independent variable and the test score as the dependent variable. Tables 6, 7, and 8 summarize these analyses.

As shown in Table 6, significant differences were found in mean Language scores for two variables. The mean Language score of students judged by the teacher as high in IQ exceeded the mean score of students judged to be average or low in IQ. Also, the mean score of students blind from birth exceeded the score of those who became blind later. No other variables showed significant differences. Data on Word Study (Table 7) revealed superior performance for students judged high in IQ. No other demographic variables showed any significant effects. Finally, data on Spelling scores are shown in Table 8. The pattern of performance was identical to that found in Language, with relative superiority being shown by the high IQ group and by students blind from birth.

As a follow-up to the univariate ANOVA's using IQ as the independent variable, a multivariate analysis of variance

(MANOVA) was performed with Teacher-Judged IQ (two levels, below average or average and above average) as the independent variable and the three test scores, Language, Word Study and Spelling, as the dependent variables. For this analysis, Pillai's trace statistic was .24965, which transformed to an exact F of 3.88 ($p < .02$). Inspection of standardized discriminant function coefficients revealed that Language scores were most important in separating the two groups of differing teacher-judged IQ. This was congruent with the univariate analyses, in which mean differences on Language were greater than on Word Study or Spelling when comparing IQ groups.

Correlational analyses were done to further explore relationships among variables. Table 9 shows Pearson correlations for the three test scores and the variable Age in Months. Age was chosen for examination because it had the most variability among the demographic variables, and thus would not be as affected by problems of restriction of the range as would other variables. Not surprisingly, the three test scores, all of which were related to verbal ability, were positively correlated with one another. Interestingly, all three were negatively correlated with age. This meant that the younger students got relatively high scores and the older students relatively low scores.

As a follow-up to the negative correlations, partial correlations were calculated. These involved again correlating age with the test score variables, but controlling for the effect

of other demographic variables. This was done to determine whether the negative zero-order correlations would increase or decrease when demographic variables other than age were brought into the analysis. Table 10 gives results of partial correlations. When Years in School, Teacher-Judged IQ, and Years of Braille Instruction were used as control variables, the inverse correlations between Age and Language and Age and Word Study shrank considerably. In fact, for Word Study, the r value was no longer statistically significant (at $p < .05$). Thus, the negative correlation between Age and Language and between Age and Word Study could be explained by three other variables.

The correlation of Age and Spelling did not markedly change, however. Other partial correlations were calculated--this time replacing the control variable Years of Braille Instruction with Age at Onset of Blindness and then with Grade Spelling Instruction Began. Not much changed; there was still an inverse correlation between Age and Spelling scores. Further analyses, perhaps multiple regression analysis might be done to further explicate the age and Spelling score relationship.

Table 6

Comparison of Mean Language Scores for Levels of Demographic Variables

Variable	Differences on Language Scores			
Years in School	ns			
IQ based on teacher judgment	Below average or average	Above average	t	p
	Mean = 36.4 n = 22	Mean = 43.2 n = 17	-3.73	.001
Age at onset of blindness	Birth	2 to 7 years	t	p
	Mean = 40.7 n = 34	Mean = 35.9 n = 9	1.98	.055
School setting	ns			
Years of braille instruction	ns			
Reading placement (grade 4 or 5)	ns			
Grade spelling instruction started	ns			
Grade contracted braille required	ns			

Note. ns = not statistically significant

Table 7

Comparison of Mean Word Study Scores for Levels of Demographic Variables

Variable	Differences on Word Study Scores			
Years in School	ns			
IQ based on teacher judgment	Below average or average	Above average	t	p
	Mean = 39.5 n = 22	Mean = 45.8 n = 17	-2.00	.053
Age at onset of blindness	ns			
School setting	ns			
Years of braille instruction	ns			
Reading placement (grade 4 or 5)	ns			
Grade spelling instruction started	ns			
Grade contracted braille required	ns			

Note. ns = not statistically significant

Table 8

Comparison of Mean Spelling Scores for Levels of Demographic Variables

Variable	Differences on Spelling Scores			
Years in School	ns			
IQ based on teacher judgment	Below average or average	Above average	t	p
	Mean = 27.5 n = 22	Mean = 32.2 n = 17	-2.16	.038
Age at onset of blindness	Birth	2 to 7 years	t	p
	Mean = 30.9 n = 34	Mean = 25.0 n = 9	2.37	.022
School setting	ns			
Years of braille instruction	ns			
Reading placement (grade 4 or 5)	ns			
Grade spelling instruction started	ns			
Grade contracted braille required	ns			

Note. ns = not statistically significant

Table 9

Pearson Correlations Among Test Scores and Age in Months

	Pearson correlations		
	Language Score	Word Study Score	Spelling Score
Age in Months	-.31*	-.22	-.39*
Language Score	--	.65**	.70**
Word Study Score		--	.61**
Spelling Score			--

*$p < .05$, two-tailed.

**$p < .01$, two-tailed.

Table 10

Partial Correlations of Age with Test Scores Controlling for Selected Variables

	Partial correlations		
	Language Score	Word Study Score	Spelling Score
Age in Months[a]	-.10	-.06	-.40*
Age in Months[b]			-.31
Age in Months[c]			-.47**

*$p < .05$, two-tailed.

**$p < .01$, two-tailed.

[a] For correlations in this row, these variables were controlled: Number of Years in School, Teacher-Judged IQ, and Years of Braille Instruction.

[b] For correlation in this row, these variables were controlled: Number of Years in School, Teacher-Judged IQ, and Age at Onset of Blindness.

[c] For correlation in this row, these variables were controlled: Number of Years in School, Teacher-Judged IQ, and Grade Spelling Instruction Began.